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AETC Incorporated

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25 July 1997

CALFED Bay-Delta Program
1416 Ninth Street, Suite 1155
Sacramento, CA 95814

Reference: 1997 Category III RFP

AETC Incorporated is pleased to submit its proposal titled "*Networked Hydroacoustic Fish Monitoring for the Bay-Delta Region*". As requested, ten copies are enclosed for your consideration.

Any questions regarding the technical content of this proposal should be addressed to Dr. Joseph Sabatini at (619) 450-1211 or e-mail: jsabatini@sd.aetc.com. Questions regarding the financial content of this proposal should be addressed to me, Steven Sands at (619) 450-1211 or e-mail: ssands@sd.aetc.com.

Sincerely,

Steven P. Sands
Vice President
Finance and Administration

Enclosure: As stated above

SPS:lew/CO-177

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I-003257

I. EXECUTIVE SUMMARY

a. Project Title and Applicant Name:

Networked Hydroacoustic Fish Monitoring for the Bay-Delta Region: San Joaquin & Tuolumne River System Demonstration

Submitted by:
AETC, Incorporated
8910 University Center Lane, Suite 900
San Diego, CA 92122

b. Project Description and Primary Biological/Ecological Objectives:

This projects seeks funding for initial field demonstration of a low cost, permanent, quantitative acoustic monitoring network for priority Bay-Delta fish species. Leveraging advanced undersea warfare experience from classified U.S. Navy contracts, the participants will assemble and test an affordable, unmanned acoustic monitoring system capable of counting and sizing fish as they pass a series of check points. Raw data from the underwater sensors will be transmitted to a central workstation facility which will process and archive data, maintain algorithms, and distribute monitoring information to multiple users via the Internet. The broad, primary benefits of such a system will be: 1) allow more efficient management of "stressor" water flows for delivery to users, while providing greater protection of fisheries resources and 2) provide consistent and legally defensible data for gauging the pace and success of Bay-Delta stressor mitigation efforts. Secondary benefits of the system include the real-time identification of high mortality areas during seasonal migrations, such as poaching, shallow water obstructions, or unscreened pump intakes for emergency action.

c. Approach/Tasks/Schedule:

We will adapt commercial off-the-shelf hardware for acoustic fish monitoring stations that will provide this valuable data at a cost of less than $5K per station by the third year. The application of proven algorithms to remotely processed data will dramatically reduce recurring costs of expensive field components. Our system source transmits a continuous wave (CW) signal rather than a broadband signal as in other commercial systems. The CW signal provides better noise rejection, lower power usage, and uses a very simple, low cost transmitter. Our single beam design also yields full channel coverages within fixed boundaries at lower cost than multi-beam systems. We avoid the need to range gate by applying Doppler processing and have the added benefit of rejecting reverberation and returns from debris moving at river speed. We will implement and test a prototype system station to monitor Chinook salmon smolts and adults during the first year of the program. During the second year of the program, we will install and test a system of three monitoring stations to determine the effectiveness of monitoring fish migration waves as a tool for adaptive management. During the third and final year of the program, we will evaluate the long-term operation of the three-station network and benchmark performance of the final $5K design sonar hardware. Field program monitoring data will be made available on the Internet. During the course of the three-year program, we will cooperate with responsible Government agencies and stakeholders to devise an overall regional monitoring and deployment plan. We will also cooperate with CALFED to obtain commercial vendors' bid information/pricing on the regional installation and maintenance of the proposed system to ensure low cost of the permanent regional system.

d. Justification for Project Funding by CALFED:

CALFED funding is appropriate for this regional project since several priority fish species (*salmonids, striped bass, and potentially splittail and delta smelt*) could be monitored in priority aquatic habitats (*instream, shaded riverine, and potentially tidal perennial*) using this system throughout the entire Bay-Delta. Successful ecological restoration and associated recovery of fish populations in the Bay-Delta System is one of the most complicated ecosystem management efforts

ever attempted. The ability to continuously and quantitatively identify variations within the fish populations will be paramount in determining successful stressor mitigation throughout this region. Continuous quantitative acoustic monitoring of fish migrations will allow for a science-based approach to *adaptive management* for water flows during periods of system strain (drought). The relative yearly population variation within these consistent regional data sets could then be used as defensible grounds for a beneficial, adaptive management approach to variations in Bay-Delta water flows.

e. Budget Costs and Third Party Impacts:
This project broadly benefits CALFED by enabling a new, low cost monitoring method for several priority fish species in priority aquatic habitats and is applicable throughout the region. This unique, networked regional approach to fish monitoring will strengthen CALFED's massive resource management and coordination efforts for ecosystem restoration and justifies program funding. There are no known or anticipated adverse third party or environmental impacts.

Incremental funding options shown are for either: 1) a *sonar hardware system* of individual nodes with continuous monitoring data stored to disk and collected periodically from each site, processed and accessed via an Internet FTP site or 2) to include an *integrated website* with the sonar system having real-time, on-line data access to all nodes with graphical interfaces and decision aids via the Internet.

	Option 1: Sonar Hardware Demo	Option 2: With Integrated Website
Three-Year Program Cost:	$619,091	$897,040

f. Applicants' Qualifications:
AETC, Inc. develops advanced algorithms for classified U.S. Navy undersea warfare systems using multiple detection methods, including state-of-the-art broadband sonar. AETC has a reputation for tailoring software to find and identify hidden objects *without requiring investment in new sensor hardware,* thereby extending the life of systems and saving the customer money. *Syzygy Technologies* specializes in design, development, integration, testing, and training of Command, Control, Communications and Information software for the U.S. Navy. *Turlock Irrigation District* has responsibility for local water resource management.

g. Monitoring and Data Evaluation:
Fish-monitoring data from this study will be cross-correlated with current California Department of Fish and Game (CDFG) monitoring methods using carcass counts, rotary screw-traps, trawls, and weir counts. Comparison of CDFG salmon carcass counts will be used to provide an overall measurement of hydroacoustic monitoring accuracy. Mid-water trawl results will supplement the hydroacoustic data with species/size data and provide a cross-check of both techniques' monitoring efficiency. Hydroacoustic data will also be used to determine the relative efficiency of the rotary screw traps for smolt out-migration. All data from the initial testing of this system will be available directly to responsible Government agencies, stakeholders, and other interested parties via the Internet. Workshops are planned during the course of the project and stakeholder/public participation will be encouraged.

h. Local Support/Coordination with other Programs/Compatibility with CALFED Objectives:
The Turlock Irrigation District is a direct participant in the proposed program and will also provide planning, assessment, and field support. Other interested agencies and groups will be invited to participate, monitor the program via the Internet, and/or attend planned workshops. It has been discussed and acknowledged at public CALFED meetings that adaptive management cannot be truly applied until baseline species population, water quality, etc., can be established and monitored consistently.

IIa. NETWORKED HYDROACOUSTIC FISH MONITORING FOR THE BAY-DELTA REGION SAN JOAQUIN & TUOLUMNE RIVER SYSTEM DEMONSTRATION

b. **Joseph Sabatini (PM)**
Steven Schmidt (PI)
AETC, Incorporated
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San Diego, CA 92122
Phone (619) 450-1211 Fax (619) 450-6729

c. **C – Corporation, for Profit**

d. **Federal Tax ID # 33-0572872**
Calif. Tax ID # 1861635

e. **Technical Contract: Joseph Sabatini**
Financial Contact: Steven Sands

b. **Participants/Collaborators in Implementation:**

Syzygy Technology Inc.	**&**	**Turlock Irrigation District**
3940 Hancock St. Suite 114		**333 East Canal Dr.**
San Diego CA 92110		**Turlock CA 95381-0949**

g. **RFP Project Group Type: Other Services**

IIIa. PROJECT DESCRIPTION AND APPROACH:

Overview: This proposal seeks to leverage significant long-term and ongoing investment by the U.S. Navy in *classified* undersea warfare hydroacoustic algorithm development and command/control technology for deployment of an *affordable, permanent, and non-fatal regional monitoring network for priority fish species*. Initially, we focus on adult fall-run Chinook salmon and smolts out-migration since this priority species is important commercially and migrates during well-defined periods. Smolt and background minnow (squawfish, blackfish, etc.) data from our tests will also be used to determine the hydroacoustic system's suitability to other priority Bay-Delta species, including Delta smelt. With the participation of the Turlock Irrigation District, sites on the Tuolumne and San Joaquin Rivers will be used to demonstrate the low cost, unmanned, sonar monitoring network in an instream habitat. The design of this system will be suitable for permanent deployments throughout the broad Bay-Delta region with a target final hardware cost of under $5K per station. All data processing will be done remotely, using advanced processing algorithms (not commercially/publicly available) by a central workstation facility that will also archive raw data. Raw and processed data from these permanent quantitative monitoring stations will be made available directly to stakeholders via the Internet. By making both raw and processed monitoring data available to stakeholders, questions associated with interpretation methods and bias will be minimized. We will also assess the total number of stations required for species monitoring, and will coordinate with responsible Government agencies and stakeholders. Since our field hardware design is based on commercial-off-the-shelf (COTS) technology, "informational" bids will be solicited from commercial vendors, such as Hydroacoustic Technology, Inc., BioSonics, Reson, etc., to provide CALFED with per station hardware deployment costing for planning purposes. AETC and Syzygy will continue to maintain the central data base and processing algorithms in cooperation with the CALFED designated lead agencies. With the cooperation of CALFED, a comprehensive regional *Bay-Delta Monitoring, Deployment, Operation & Costs Plan* will be compiled so that priority regional monitoring sites can be budgeted and installation begun by the turn of the century.

Hydroacoustic Hardware Design: The system will be a series of stationary sonar monitoring "check points" placed in strategic nodes in the Bay-Delta region. At each node, the sonar will continuously monitor the movement of fish, providing information on speed, number of fish, and size of the fish traversing the node. The system is unmanned, uses low cost COTS components, and the data obtained will be processed remotely in real time. Data will be linked to a WWW-accessible data base which can be accessed to provide a quantitative measure of the fish populations in the region. The methods and algorithms required for system implementation have been successfully used by the U.S. Department of Defense for underwater monitoring and target identification in shallow water and the data base management system is currently being used in U.S. Naval Forces' latest command and control systems. The sonar system consists of a single, directional low power (<1 watt) high frequency (100–500 kHz) continuous wave (CW) source placed underwater on one side of the river intercept point (bridge piling, etc.) and an omnidirectional, calibrated hydrophone placed underwater on the opposite side. The source has a total beam width of about 20 degrees in the horizontal and vertical dimensions. Placing the receiver on the opposite side of the river allows the system to take advantage of a well-known phenomena called near forward scatter in which the scattered signals from fish are increased by 20-30 dB over the conventional monostatic systems, such as those used in typical commercial fish monitoring systems. This allows for much lower transmitter power and will permit long-term, unattended battery-powered operations (if desired). The high frequency, low power CW system is inexpensive, can reject noise very effectively, will not affect the fish in any adverse fashion, and will not suffer from significant loss due to absorption or spreading in these geometries.

The system uses a well-established and successful technique called "Doppler processing," which measures fish speed and discriminates the moving fish from the stationary reverberation and from the water-borne debris, such as submerged logs or bubbles. These Doppler processing methods are extremely robust and simple to implement from these geometries. The output of this processor is a time series of the "Doppler Spectrum" obtained every few seconds, which can be used with validated scattering models developed for the U.S. Navy to infer the average fish velocity (both magnitude and direction) with resolution of ≈0.01 m/sec, the number of fish, and fish size at each node. The data will be digitized and linked by phone in real time into a data base available through a website on the Internet.

Figure III.1 illustrates system deployment in a river environment. A directional acoustic source is fixed to the riverbank at mid-depth. The source has a conical beam pattern of 10 to 20 degrees in the horizontal and vertical directions and is oriented such that its energy is directed upstream. A low energy, continuous wave (CW) acoustic signal between 100–500 kHz is transmitted and ensonifies all objects within the beam. The volumetric coverage, continuous transmission, and short wavelength ensure that all objects large and small, moving in any direction, will be observed. The transmitted energy is scattered forward towards the receiver. Studies have shown that this forward scatter energy is 10 to 20 dB greater than the energy backscattered toward the source. This scattered energy is received at an omnidirectional hydrophone positioned at mid-depth on the opposite riverbank. Expected Signal-to-Noise Ratio (SNR) is 20 to 30 dB. The output from the hydrophone is mixed with the 100 kHz carrier, filtered, digitized, and processed giving Doppler velocity spectral estimates every second. These spectra are then relayed to an off-site facility for processing through analysis algorithms and for display and archive of results.

The two fundamental properties associated with this system are: 1) Signal scattered from a moving object undergoes a frequency shift relative to the object's velocity. 2) The scattering strength of the object determines the amplitude of this frequency-shifted signal. The received scattering amplitude versus Doppler frequency is the Doppler Velocity Spectrum. Figure III.2 is an example of a such a Doppler velocity spectrum. For a given velocity, the amplitude of this curve is indicative of the overall scattering strength of objects moving at this velocity. Thus, it provides a means to discriminate among objects with different velocities. For example, stationary objects (the river bottom and its banks) have a high scattering strength and have zero velocity. Their amplitudes are very high and are centered at zero velocity. This amplitude does not change with time. Referring to Figure III.1, fish within the beam moving upstream will be receding from the source and receiver. They have a negative Doppler velocity with a mean value which relates to their speed and spatial distribution. The area is a function of fish size, number, and distribution within the beam. The spread of energy about this mean velocity (variance) provides information on the spatial and velocity distribution of the fish. Likewise, fish moving downstream will be closing the source/receiver pair and will have a positive Doppler velocity with the same information inherent in their distribution. Finally, objects moving at river velocities (e.g., bubbles, flotsam, etc.) will appear with a positive Doppler velocity below that of downstream moving fish. Thus, the Doppler velocity spectrum is used to: 1) separate the fish from the reverberation and non-fish, and 2) provide continuous measurements of fish number, size, velocity.

The Doppler velocity spectra are processed over one-second time periods and integrated over longer time periods (e.g., minutes, hours, days, etc.) to extract desired monitoring information. Figure III.3 is an example of an "Intensity Gram" of the Doppler velocity spectra as a function of time. These Intensity Grams can be thought of as a series of Doppler Velocity Spectra (Figure III.2) viewed from above, showing only peak data. First, note that the reverberation stays centered on zero and does not change. The left half of the display (negative Doppler) is where the upstream moving fish will appear. Large fish will have a higher intensity (appear brighter) and will have a wider track (greater velocity spread). A submerged object flowing with the river will appear on the right half of the display with velocity magnitude lower than that of the downstream moving fish. Thus, we can combine these fish (target) tracking and interpretation methods/algorithms to

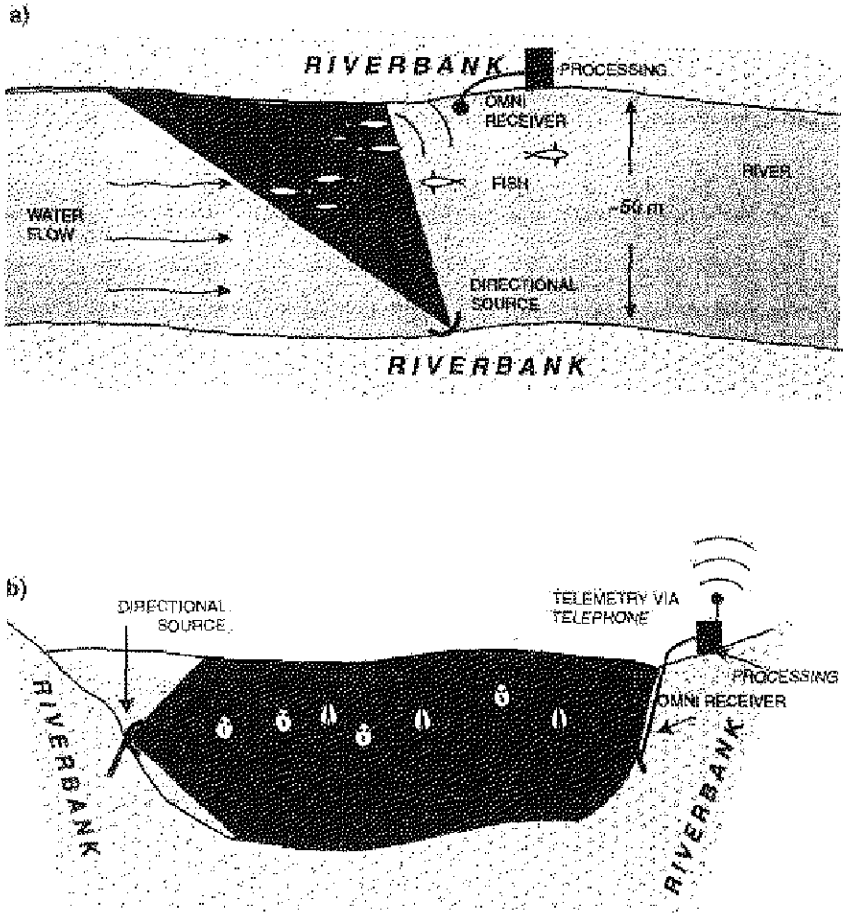

Figure III.1. Simple Deployment Geometry for Low Cost Sonar System: a) Plan View; b) Cross-Section View. (Note the broad coverage provided by the directional source.)

Figure III.1

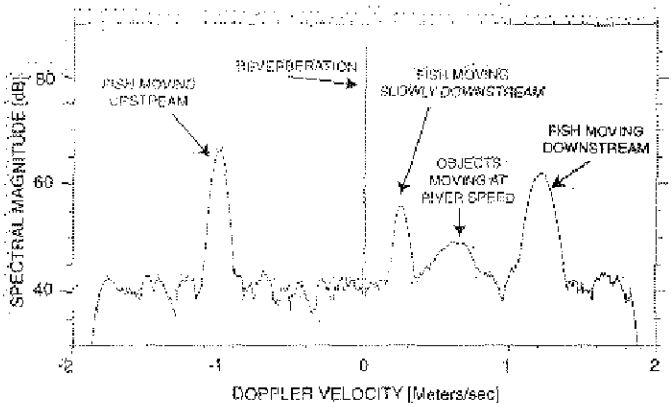

Figure III.2. Doppler Processing Spectrum Illustrating Relative Signal Locations of Various Objects.

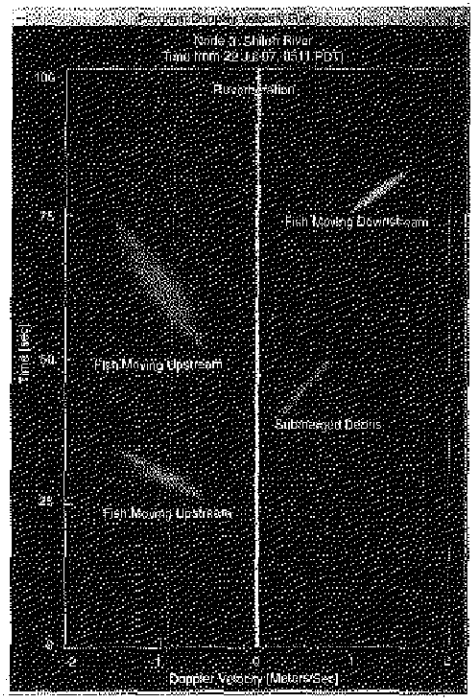

Figure III.3. Real-Time Display of Proposed Sonar System.

Figures III.2 and III.3

eliminate noise and yield very reliable real-time monitoring of fish population, size, and migration speed. Over long time scales, diurnal and seasonal trends can be monitored.

Table III.1 presents a comparison of existing commercial vendor systems with the AETC system approach. The planned geometry takes advantage of the much higher forward scattering strength of the fish, thus allowing for a very low power signal. Using a CW system provides excellent noise rejection and lower power and cost. Use of Doppler processing mitigates reverberation from stationary objects, such as the river bottom and banks, and measures the direction and speed in of the fish. Finally, using a network of low cost systems interspersed along a river and linked to a central computing facility provides a continuous measure of fish migration trends over space and time in real time.

Field calibration (i.e., ground truthing) of the hydroacoustic data will be conducted through the three-year program as needed to provide definitive confirmation of fish species' identification and size. This calibration will be accomplished in conjunction with existing inventory and monitoring programs, such as carcass and wier counts, rotary screw-trap surveys, and mid-water trawl surveys. Additional methodologies, such as direction observation, electrofishing, fike-nets, and seining, may also be employed.

It is important to point out that there are few absolutes in data collection. The detailed resolution of our proposed low cost monitoring system will obviously be less than is possible using much more expensive hardware. However, as an overall regional Bay-Delta resource management tool, a network of ~50(?) permanent real-time fish monitoring checkpoints is more valuable than seasonal deployment of only a few expensive dual, split, etc., beam tracking systems. Only a permanently installed regional network of fish monitoring stations can provide internally consistent statistical variations that can truly assess Bay-Delta aquatic ecosystem restoration efforts.

Internet Link, Data Processing/Distribution, Webpage: The proposed system of geographically distributed low cost acoustic sensors will provide a high volume of real-time data indicating the migration of priority fish species. Reduction of this raw field data will be conducted at Syzygy in San Diego, where the processing algorithms developed by AETC will be hosted on workstations. As this program proceeds, processed data will be used to populate decision aids used in adaptive management, and for near real-time generation of static graphical displays for stakeholders. In addition, sensor data will be archived to allow for historical re-analysis by interested parties if so desired.

Figure III.4 depicts the software components that will be developed. The Communications Server (Comms Server) component monitors incoming data lines for raw data from the remotely-placed data acquisition systems. The Comms Server then archives this information as raw data files, and applies algorithmic transformation to create processed data (consisting of the statistical number of fish, type, velocity, etc.). This synthetic data is saved in a historical, relational data base, and the Comms Server notifies the Data Server that a change has been recorded. The MMI Server is responsible for updating static HTML pages and handling remote, dynamic client requests for data retrieval purposes.

The data server and graphical user interface will take advantage of modern object-oriented design techniques, allowing for modular design, phased implementation, and low maintenance costs. The data server will receive, store, correlate, and disseminate information while the user interface will graphically present the data to the user. When raw data is received from the sensor array, it will be parsed and stored by the data server. The data server will then provide real-time updates to adaptive management decision aids. The data server also processes data required to generate near real-time static graphical displays in response to user defined queries.

Table III.1. Relative Advantages of Proposed Multi-Node Monitoring System over Existing Commercial Systems.

System	Parameter							
	Noise Immunity	Reverberation Immunity	Unmanned	Fish Direction of Travel	*Migration Trends*		Power	Cost
					Spatial	Temporal		
AETC Multi-Node Doppler Velocity	**Excellent**	**Excellent**	**Yes**	**Excellent**	**Excellent**	**Excellent**	**Low**	**Low**
Existing Commercial/ Vendor Systems *	Good	*Poor*	No	Good	None	**Excellent**	High	High

* Includes typical multiplexed, single, dual beam, and split beam methods with and without tracking.

Table III.1

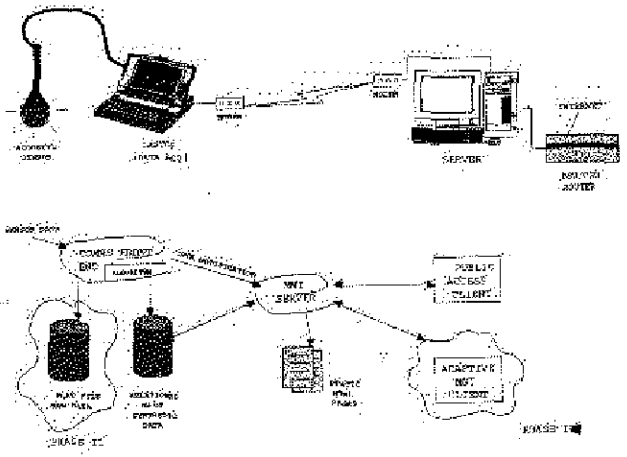

Figure III.4. Proposed Real-Time Data Server System Design. (Option 2, Section IV)

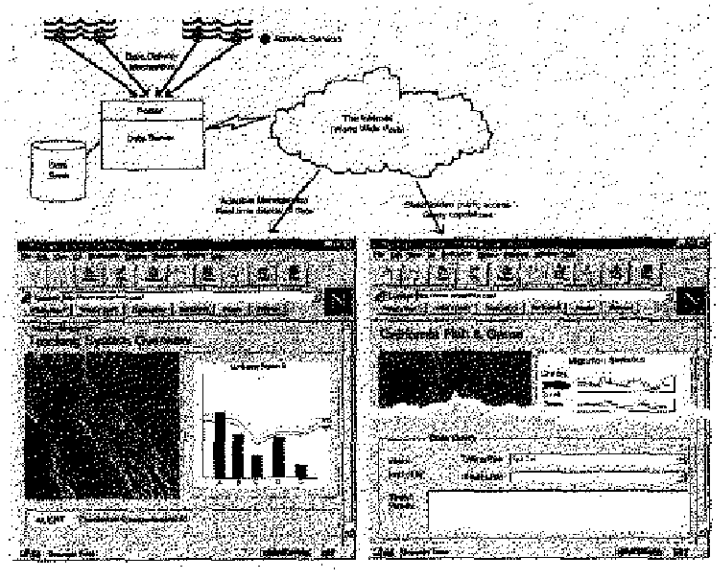

Figure III.5. Conceptual Website User Interface. (Option 2, Section IV)

Figures III.4 and III.5

All user interfaces will be developed using JAVA, object-oriented programming techniques or applications which are accessible from the world-wide-web (WWW). This will provide hardware/computer independence and exploit the public's familiarity with the Internet. Three classes of user interfaces will be provided: 1) real-time adaptive management decision aids, 2) near real-time static graphical information displays, and 3) raw data query forms. These user interfaces will be designed with coordination from responsible Government Agencies and stakeholders to maximize efficiency.

The Phase III decision aids will provide real-time display of data by adapting proven components of current United States Naval Command and Control systems. Information to be displayed in a real-time basis would include the number of fish passing a checkpoint as well as the average direction and speed. Given this information, a decision aid will predict the number of fish and their expected time of arrival at the next up or downriver checkpoint. If the number of fish arriving at subsequent checkpoints falls below a specified threshold, the decision aid will alert the user that emergency stressor mitigation may be required.

Graphical display of near real-time static information will include information such as charts, graphs, and images, which can be made available on the WWW for stakeholders and for the general public (Figure III.5). This graphical information will provide users with information about total fish migration/population. Data base assess levels, filters, or delays will also be utilized to prevent system misuse as a new poaching tool. Future developments can be easily updated to provide additional metrics as required and include water quality, flow, temperature, etc., links.

The third type of user interface will be a query menu, which will allow observers to obtain specified information from the data base for selected periods. This interface will also allow the user to obtain data for further analysis in an off line, non real-time mode.

b. Location and Geographic Boundaries: The initial Tuolumne and San Joaquin River site(s) for system deployment and testing were recommended by the Turlock Irrigation District (Figure III.6). Collectively, these sites apply to the San Joaquin River Watershed. The first year deployment site will be at the Shilo Rd. crossing of the Tuolumne River in Stanislaus County. These sites offer bridges for mounting sensors, a gauging station, electrical power, and telephone lines, allowing for easy field deployment of equipment. The river is relatively narrow at this point, with a smooth sloping sandy bottom ensuring near ideal conditions for hydroacoustic monitoring (Figure III.7). Additionally, two other wider sites along the San Joaquin River in San Joaquin County will be used during the second and third year tests when actual station-to-station monitoring/tracking of the salmon migration pulse will be conducted. These progressively wider river sites are located at bridge crossings near the towns of Vernalis (Airport Road) and Mossdale (Interstate 205) (Figure III.6). The Mossdale location has been used by California Dept. of Fish and Game (CDFG) as a mid-water troll fish monitoring station since the 1980s, providing cross-correlation of results and speciation data.

c. Expected Benefits: The focus of this study is to provide a reliable monitoring system for priority fish species (salmonids, striped bass, and potentially splittail delta and longfin smelt) in priority habitats (instream, shaded riverine, and potentially tidal perennial). The broad, primary benefits of this monitoring system will be: 1) allow more efficient management of "stressor" water flows for delivery to users and hatcheries while providing greater protection of fisheries resources, and 2) provide consistent and legally defensible data for CALFED to gauge the success of "Adaptive Management" tests and Bay-Delta stressor mitigation efforts. Secondary benefits of the system include the real-time identification of high mortality areas during seasonal migrations, such as poaching, shallow water obstructions, or screened pump intakes for emergency action. Potential CALFED and third party benefits are to support larger sustainable fish populations for both commercial and sport fishermen.

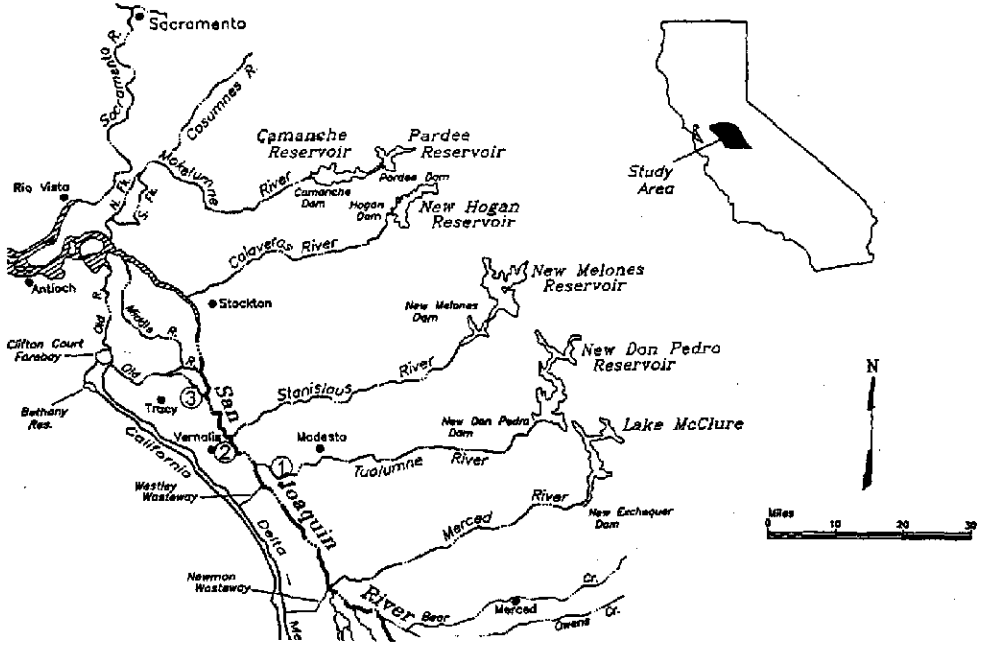

Figure III.6. Location Map Showing Proposed Monitoring Stations: 1) Shilo Road, Tuolumne River; 2) Airport Road, San Joaquin River; and 3) Interstate 205/Mossdale, San Joaquin River.

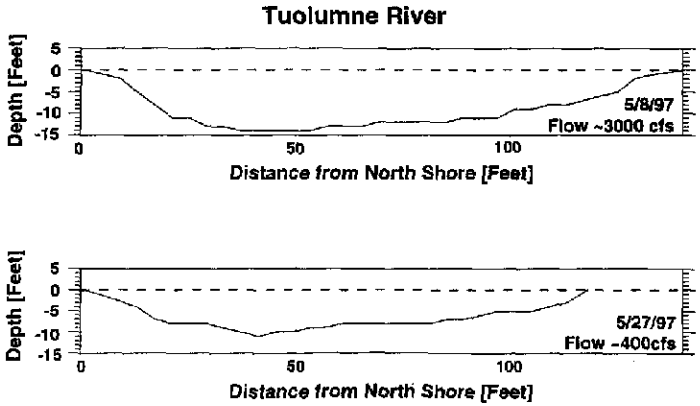

Figure III.7. 1997 Stream Profiles Provided by CDFG (Tim Heyn) of the Tuolumne River at Shilo Road Bridge. No vertical exaggeration. 20° beam covers entire channel.

Figures III.6 and III.7

d. Background and Biological/Technical Justification: The numbers of migrating adult Chinook salmon are currently estimated by a variety of inconsistent, labor-intensive methods, such as wier or carcass counts (where the number of fish is not known until weeks after the survey). Current methods for quantifying the number of out-migrant smolts are also labor-intensive and in need of improvement. For example, the effectiveness of rotary screw-trap sampling in rivers, including the Tuolumne, has been tested recently with generally poor results. Problems included larger smolts avoiding the traps and poor daylight catches compared to those of the night. In the lower delta, the mid-water trawl sampling conducted by CDFG has been fairly successful in determining near real-time fish distribution data. However, this methodology is also labor-intensive, subject to a number of sampling biases, has high mortality for some species, and does not provide for quantifying fish on a system-wide basis. Several commercial companies offer quite good manned hydroacoustic systems suitable for detailed seasonal use, yet the cost and labor of these systems would be prohibitive for permanent wide deployment of multiple stations in the vast Bay-Delta. The new system and program we propose will be both low cost and unmanned, making a permanent network of monitoring stations possible within reasonable financial constraints. The permanence of monitoring stations will be essential in providing consistent legally defensible data for water management over the periods of many years. This program will provide lasting benefit to management of Bay-Delta resources. Uncertainty will always remain as to the absolute number of fish passing even permanent hydroacoustic check points. The yearly relative percent variation (up or down) will be a very reliable and legally defensible assessment tool for determining the total success of other stressor mitigation efforts.

e. Proposed Scope of Work: We propose a scope of work that is separated into three individual year long phases. Each year phase has clearly defined performance criteria for continuing to the next year. The first phase of the program is to assemble and field test the basic sonar system on smolt and adult Chinook salmon (~2 weeks each). This prototype ("breadboard") system will be constructed using higher cost commercial, "research grade" components to allow more flexibility (tuning) of specific design parameters to these monitoring applications. The second phase of the program will use the Phase I design results to specify/build two additional pre-production ("brassboard") systems at ~50 percent lower cost by using more single function components. Specifically, we will target the power amplifier, transmitter, and hydrophone for order of magnitude cost reductions. All three complete systems will then be field tested/cross-checked for networked monitoring of a complete Spring out-migration of smolt and Fall run of salmon (~3 months total). Information from these tests will then be used to request "production" system bids from commercial vendors for the final $5K target price. Additional 50 percent cost reduction of the production sonar hardware will be accomplished by using a dedicated combined data processing board, thereby eliminating the remaining costly individual components (laptop computer, signal conditioning, and data acquisition). During Phase II, we will also calibrate and coordinate results with other ongoing monitoring programs in this area. Results and regional planning will be discussed at a two-day workshop planned for Fall 1999. Phase III of the program will test two new vendor-built, low cost $5K systems along side those systems used in Phase II. These tests will include long-term monitoring (~9 months) and a short, single station test for delta smelt, striped bass, etc.

Technical and financial reporting will be conducted on a quarterly basis during all phases. Major milestones are given below with individual tasks detailed in Section IV.

Phase I:
- Hardware acquisition and pre-field assembly and testing (tank or hatchery wet tests)
- Field test of unmanned sonar monitoring system of adult salmon & smolts (Lower Tuolumne River site, 2 weeks/each spring & fall).
- Design test of WWW data server, AETC data processing algorithm output, and link to CALFED and other monitoring program web sites
- Basic website data server (Option 2, Sec. IV)
- *Phase I, Results and recommendations report*

Phase II
- Three station migration test on adults and juvenile salmon (Lower Tuolumne and San Joaquin Rivers 2-3 month duration, Spring and Fall)
- Evaluation and application to other priority species (Delta Smelt etc.)
- Long term system demonstration (Tuolumne River site, 9-10 months)
- RFQ for vendor installation of regional monitoring system hardware
- Integration workshop/outreach for stakeholders
- Real-time website data access (Option 2, Sec. IV)
- *Integration plan for data server with Government agencies and stakeholders*
- *Phase II results and recommendations report*

Phase III:
- Delta smelt monitoring test (if appropriate)
- Long term (~1 yr.) Tuolumne and San Joaquin Rivers, 3 station test
- Website with real-time decision aids, cross-links, etc. (Option 2, Sec. IV)
- Final Report, regional deployment, operations and costs plan for hydroacoustic monitoring systems

f. Monitoring and Data Evaluation: Our proposed monitoring program and data evaluation differs significantly from current hydroacoustic monitoring approaches since: 1) we use low cost, reliable CW rather than more complex beamforming sonar methods; 2) we reduce deployment costs by having raw data processed at the central server, not each monitoring site; and 3) both raw and processed data will always be available to stakeholders via the WWW. (See Table III.1.) Our approach allows for stakeholders and other researchers to use and/or compare AETC server hosted hydroacoustic algorithms results with any other third party algorithms, providing ongoing peer review. The hydroacoustic fish monitoring information will also provide linkages to other current/future State and Federal monitoring data web sites on water quality, temperature flow among others. Coordination and integration with other programs will be led by the Turlock Irrigation District and assisted by AETC's Stockton-based fisheries biologist. Fish monitoring data from this study will be cross-correlated with current CDFG monitoring methods using carcass counts, rotary screw-traps, trawls, and weir counts. Comparison of CDFG salmon carcass counts will be used to provide an overall measurement of hydroacoustic monitoring accuracy on adult salmon. Mid-water trawl results (at Mossdale, Figure III.6) will supplement the hydroacoustic data with species/size information and provide a cross-check of both techniques monitoring efficiency. Hydroacoustic data will also be compared with the rotary screw-traps for smolt out-migration.

g. Implementability: The proposed work is generally non-intrusive as once the stations are deployed, the hydroacoustic monitoring does not harm fish or change the physical attributes of the environment. Environmental compliance will include permitting pursuant to the Clean Water Act and Rivers and Harbors Act, as well as coordination with U.S. Fish and Wildlife Service and CDFG for Incidental Take of listed species. It is anticipated that the proposed work will be categorically exempt from CEQA and categorically excluded from NEPA. Coordination with other monitoring projects will be lead by Turlock Irrigation District with additional support from our biologist who works extensively with surrounding irrigation districts. Outreach will be provide through a continuously updated web site maintained by Syzygy and linked to the CALFED web site.

IV. Costs and Schedules

This project has broad overall benefits to the CALFED program by enabling a new, low cost monitoring method for several priority fish species in priority aquatic habitats, applicable throughout the region. This unique, networked regional approach to fish monitoring will strengthen CALFED's massive resource coordination efforts for ecosystem restoration and justifies program funding.

We have costed the overall three-year program as three distinct, one-year phases as shown in the attached tables. Incremental funding options are for either: 1) a basic sonar system of individual nodes (checkpoints) with continuous monitoring data stored to disk (Jazz drive, etc.) and collected periodically from each site, processed, and results accessed via FTP with the Internet, or: 2) with integrated website monitoring system having real-time, on-line data access with graphical interfaces and decision aids via Internet www page to all nodes. For clarity of presentation, we have only described the fully integrated system within Section III; however, option tasks are detailed in the accompanying cost schedules.

AETC is a government contractor whose customers are the DOD (Department of Defense) and private industry. As such, AETC is frequently audited by the Defense Contract Audit Agency (DCAA) and all rates shown on the labor schedule (Table IV.1) are approved by the DCAA for proposals and billings submitted to the U.S. Government. The costs shown on (Table IV.2) are pass-through costs and do not include any overhead, G&A or fee. They do however, include contingencies on travel and equipment estimates as indicated below.

The accompanying cost schedules include contingencies for escalations and underestimates as follows: 1) labor includes a 4% annual escalation, effective July 1 each year starting with 7/1/98; 2) travel includes a 5% contingency and; 3) equipment includes a 15% contingency for unanticipated costs such as shipping, handling, warranty and license fees.

Operations and Maintenance (O&M) of the sonar field system for the duration of the program has been included in costing and will be led by AETC. Turlock Irrigation will also provide additional field and O&M support as part of routine operations as available. As the program proceeds CDFG and other interested parties will be given the opportunity to view/train on field demonstrations to aid in final determination of projected O&M costs for operation by various groups (State, Federal, Local) for future deployment of the Bay Delta regional monitoring network. Future funding needs will be determined by regional responsibility for relative fish species monitoring and could be State, Federal, Local and/or CALFED. The amount of such funding will be ultimately determined by the total number of monitoring stations desired.

While Turlock Irrigation District is a direct participant in this proposal, specific cost sharing is not called out since planned activities are part of normal ongoing operations. The real cost share benefit

of this program to CALFED is from the multi-million dollar prior and ongoing investments made the U. S. Department of Defense in sonar technology methodology at AETC. Essentially this will be a technology transfer program whereby CALFED will be able to access the most advanced sonar expertise in the world.

AETC is a small, disadvantaged business concern and does not have a formal subcontract bid and evaluation process in place. However, equipment procurement bids will be solicited from at least three different sources, whenever possible. Some specialized equipment may be required and these items will include a sole source justification.

Schedule milestones are shown as Tables IV.3.2, 4.2 and 5.2

AETC does not anticipate any Third Party Impact, adverse or otherwise, in the performance of this work.

The accompanying cost tables are as follows:

Table IV.1	-	Total Labor Cost/Price
Table IV.2	-	Pass-through Costs, Total Costs (Phase 1-3) and Website Option
Table IV.3.1	-	Phase I Project Tasks/ Costs
Table IV.3.2	-	Phase I Schedule Milestones
Table IV.4.1	-	Phase II Project Tasks/ Costs
Table IV.4.2	-	Phase II Schedule Milestones
Table IV.5.1	-	Phase III Project Tasks/ Costs
Table IV.5.2	-	Phase III Schedule Milestones
Table IV.6	-	Equipment List/Costs
Table IV.7	-	Estimated Travel Detail - San Diego to Modesto
Table IV.8	-	Estimated Travel Detail - San Diego to Sacramento

AETC will provide quarterly reports with each (annual) phase of the contract. Monthly progress billings will be submitted with a final quarterly billing submitted with each quarterly report.

Cognizant DCAA office: DCAA, 7675 Dagget St., Suite 200/300,
San Diego, CA 92111
Phone No. (619) 616-8899

DATE: 7/22/97 SD-97-110
POP: October 1997 thru September 2000

Labor Category	Rate	PHASE I Oct 97 - Sept 98 Hours	PHASE I Costs	PHASE II Oct 98 - Sept 99 Hours	PHASE II Costs	PHASE III Oct 99 - Sept 00 Hours	PHASE III Costs
Program Mgmnt	63.07	120	7,568	170	10,722	120	7,568
Principal Investigator	35.32	400	14,128	500	17,660	360	12,715
Associate Tech	25.42	600	15,252	760	19,319	540	13,727
Total Technical		1,120	36,948	1,430	47,701	1,020	34,010
Technical Assistant	18.50	220	4,070	280	5,180	200	3,700
Labor Subtotal		1,340	41,018	1,710	52,881	1,220	37,710
@ 4% On labor after 7/1/98			410		2,115		1,508
@ 4% On labor after 7/1/99					550		1,569
@ 4% On labor after 7/1/00							408
Direct Contract Labor		1,340	41,428	1,710	55,546	1,220	41,195
Labor Benefits	45.20%		18,726		25,107		18,620
Total Direct Labor		1,340	60,154	1,710	80,653	1,220	59,815
Overhead Costs	54.78%		32,952		44,182		32,767
Basis for G&A			93,106		124,835		92,582
G&A Expense	17.73%		16,508		22,133		16,415
Cost Subtotal			109,614		146,968		108,997
FCOM (Labor)	0.009147		550		738		547
FCOM (G&A)	0.000178		17		22		16
Total Estimated Costs			110,181		147,728		109,560
Fixed Fee	10.00%		10,961		14,697		10,900
Total Labor Price			**121,142**		**162,425**		**120,460**

Table IV.1

DATE: 7/22/97 SD-97-110

POP: *October 1997 thru September 2000*

		PHASE I Oct 97 - Sept 98		PHASE II Oct 98 - Sept 99		PHASE III Oct 99 - Sept 00	
		Hours	Costs	Hours	Costs	Hours	Costs
Total Labor Price From Previous Table		1,340	121,142	1,710	162,425	1,220	120,460
COST PASSTHRU							
Estimated Travel	Rate	Trips		Trips		Trips	
S.Diego-Modesto							
6 Trips/8 nights ea	$1,680	6	10,080		0		0
24 Trips/5 nights ea	$1,201		0	12	14,412	12	14,412
S.Diego-Sacramento							
10 Trips/1 night ea	$416		0	4	1,664	6	2,496
Consultants	Rate	Hours		Hours		Hours	
Field Technician	$45.00	200	9,000	400	18,000	400	18,000
Diane Moore	$75.00	200	15,000	240	18,000	400	30,000
Wayne Sawka	$80.00		0	50	4,000		0
Other Cost Items	Rate	Units		Units		Units	
Equipment Phase I	$20,000	1	20,000		0		0
Equipment Phase II	$15,000		0	2	30,000		0
Equipment Phase III	$5,000		0		0	2	10,000
Total Sonar Price			**175,222**		**248,501**		**195,368**
WEB-SITE OPTION		Hours		Hours		Hours	
Develop & Support		1,680	95,763	1,644	91,780	1,880	90,406
Total Price W/Web-Site Option			270,985		340,281		285,774

Table IV.2

DATE: 7/22/97 SD-97-110
POP: Oct 97 thru Sept 98

PHASE I

Project Task and Phase	Direct Hours	Dir.Lbr +Benefits	Ovhd,G&A and Fee	Travel Cost	Svc Agree/ Consultants	Equipment Purchases	Total Cost/Price
1. Hardware specs, bid & acquisition	80	3,591	3,641			20,000	27,232
2. Prefield hardware assembly & test	200	8,978	9,102				18,080
3. Spring/Fall field test	400	8,978	9,102	10,080	9,000		37,160
4. Data analysis & algorithm models	400	17,956	18,205				36,161
5. Local coordination & permits	120				9,000		9,000
6. Monitoring data output, Formating/Interface	200	8,978	9,102				18,080
7. Biological data assessment	80				6,000		6,000
8. Program Management	160	7,182	7,282				14,464
9. Report preparation	100	4,491	4,553				9,044
Sonar Costs - Phase I	**1,740**	**60,154**	**60,988**	**10,080**	**24,000**	**20,000**	**175,222**
OPTION TASK Syzygy - Web Site Develop & Support	1,680				95,763		95,763
Total Cost w/Option Task	3,420	60,154	60,988	10,080	119,763	20,000	270,985

Table IV.3.1

I—003276

I-003276

PHASE I

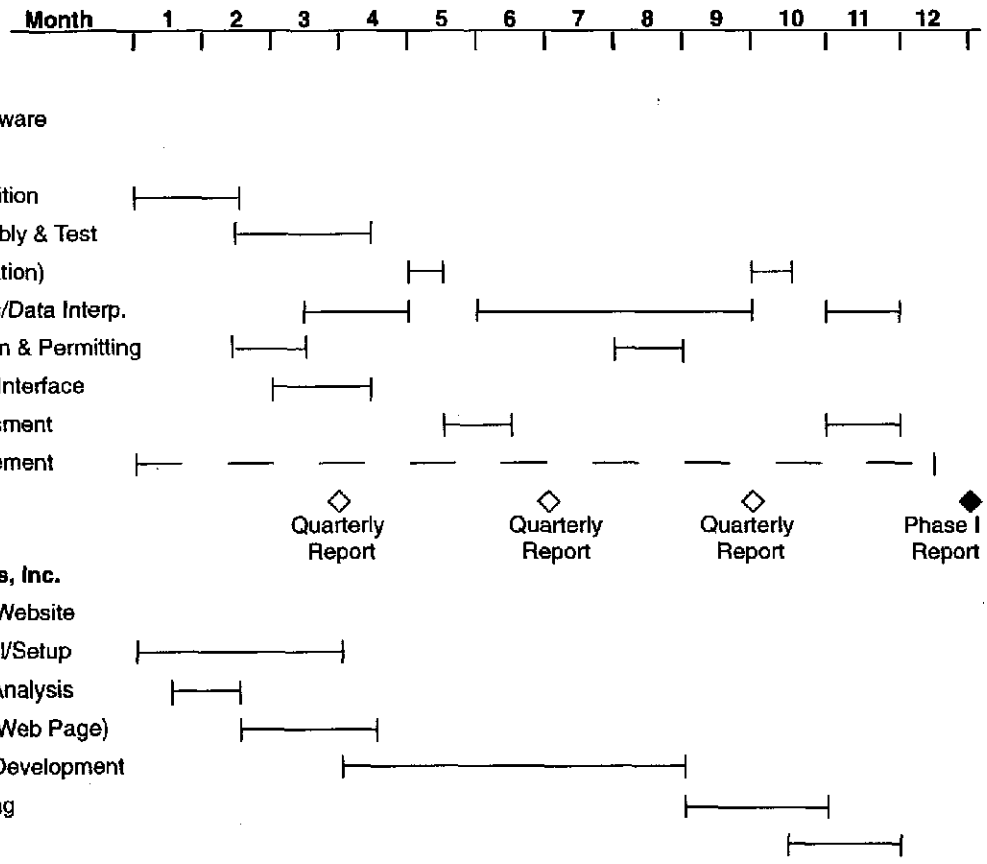

Table IV.3.2

DATE: 7/22/97 SD-97-110

POP: Oct 98 thru Sept 99 **PHASE II**

Project Task and Phase	Direct Hours	Dir.Lbr +Benefits	Ovhd,G&A and Fee	Travel Cost	Svc Agree/ Consultants	Equipment Purchases	Total Cost/Price
1. Hardware acquisition	80	3,773	3,825			30,000	37,598
2. Prefield assembly, test, network	300	14,150	14,346				28,496
3. Spring/Fall testing (3 stations)	600	14,150	14,346	14,412	13,500		56,408
4. Long term test	200	4,717	4,782		4,500		13,999
5. Data analysis & algorithm models	200	9,434	9,565				18,999
6. Local coordination & permits	120				9,000		9,000
7. Biological evaluation assessment	120				9,000		9,000
8. Multi-Node data interface	280	13,206	13,390				26,596
9. Vendor hardware bid/evaluation	80	3,773	3,825				7,598
10. Coordination workshop @ CALFED	100	2,358	2,391	1,664	4,000		10,413
11. Program Management	160	7,546	7,651				15,197
12. Report preparation	160	7,546	7,651				15,197
Sonar Costs - Phase II	**2,400**	**80,653**	**81,772**	**16,076**	**40,000**	**30,000**	**248,501**
OPTION TASK							
Sysygy - Web Site Develop & Support	1,644				91,780		91,780
Total Cost w/Option Task	4,044	80,653	81,772	16,076	131,780	30,000	340,281

Table IV.4.1

PHASE II

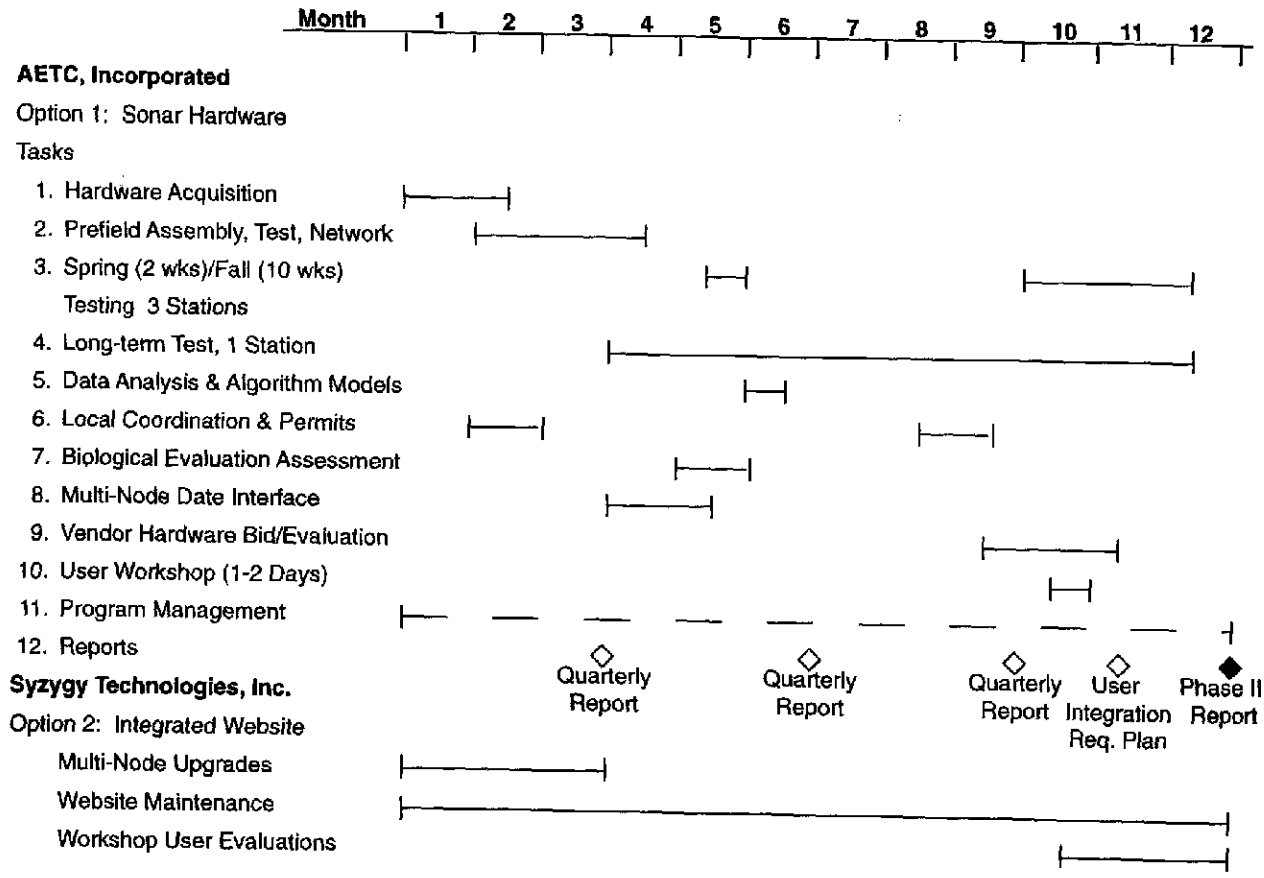

Table IV.4.2

DATE: 7/22/97
POP: Oct 99 thru Sept 00

SD-97-110

PHASE III

Project Task and Phase	Direct Hours	Dir.Lbr +Benefits	Ovhd,G&A and Fee	Travel Cost	Svc Agree/ Consultants	Equipment Purchases	Total Cost/Price
1. Delta Smelt system test	200	4,903	4,971	4,804	4,500		19,178
2. Pre/Post field assembly test & mods	100	4,903	4,971				9,874
3. Long term 3 station test	600	14,709	14,913	9,608	13,500		52,730
4. Acquisition, test, calibrate vendor supplied production system	120	5,883	5,965			10,000	21,848
5. User data output additions/mods	200	9,806	9,942				19,748
6. Coordinate w/CALFED on regional deployment	280	3,921	3,975	2,496	15,000		25,392
7. Biological results assessment	200				15,000		15,000
8. Program Management	160	7,845	7,954				15,799
9. Report preparation	160	7,845	7,954				15,799
Sonar Costs - Phase III	**2,020**	**59,815**	**60,645**	**16,908**	**48,000**	**10,000**	**195,368**
OPTION TASK							
Syzygy - Web Site Develop & Support	1,880				90,406		90,406
Total Cost w/Option Task	3,900	59,815	60,645	16,908	138,406	10,000	285,774

Table IV.5.1

I—003280

I-003280

PHASE III

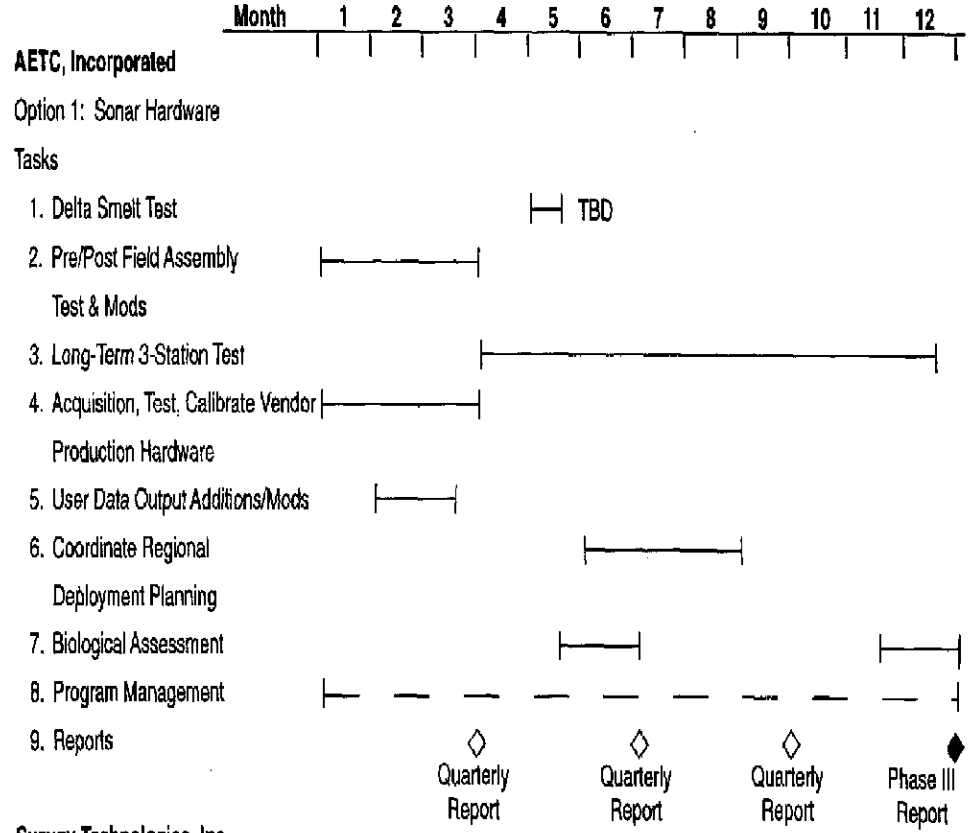

Table IV.5-2

DATE: 7/22/97 SD-97-110
POP: Oct 1997 thru Sept 2000

EQUIPMENT LIST

TRANSMIT EQUIPMENT Function	Hardware Example	Estimated Costs
Waveform Generator	Wavetek Signal Generator	$247
Power Amplifier	Kronhite 7500	4,014
Transmit Source	ITC 3003G	2,294
Cables, Connectors, Etc	Various	573
	Total for Transmit Equipment =	$7,127
RECEIVER EQUIPMENT Function	Hardware Example	
Hydrophone (receiver)	ITC 8084	$3,125
Signal Conditioning/mixing and filtering	Various	2,294
Data Acquisition	National Instruments AT DSP2200	3,211
Personal Computer	Pentium w/accessories	2,294
Cables, Connectors, Etc	Various	573
Software Compiler	Various	229
Underwater Mounting Hrdware	To be determined	1,147
	Total for Receiver Equipment =	$12,873

	Units	Unit Cost	
Estimated Equipment Costs - Phase I	1	$20,000	$20,000
Estimated Equipment Costs - Phase II	2	$15,000	$30,000
Estimated Equipment Costs - Phase III	2	$5,000	$10,000

Table IV.6

AETC

ESTIMATED COSTS

TRAVEL

SAN DIEGO, CA TO MODESTO, CA
MODESTO, CA TO SAN DIEGO, CA

NIGHTS STAY IN HOTEL:	1	2	3	4	5
AIR FARE (1)	350	350	350	350	350
GROUND TRANSPORTATION (2)	60	120	180	240	300
PER DIEM (3)	68	102	136	170	204
HOTEL/LODGING	58	116	174	232	290
SUBTOTAL	536	688	840	992	1,144
PROVISION FOR COST INCREASE AT 5%	27	34	42	50	57
TOTAL	563	722	882	1,042	1,201

Note: Add $160 for each additional 24-hour period in the following increments:

GROUND TRANSPORTATION	$ 60
PER DIEM	$ 34
HOTEL/LODGING	$ 58
COST INCREASE PROVISION	$ 8

(1) COACH AIR FARE 7/21/97 $ 350

(2) GROUND TRANSPORTATION INCLUDES:
MILEAGE, PARKING, CAR RENTAL, TAXI/CABFARES

(3) PER DIEM AND HOTEL IN ACCORDANCE WITH JTR

Table IV.7

AETC

ESTIMATED COSTS

TRAVEL

SAN DIEGO, CA TO SACRAMENTO, CA
SACRAMENTO, CA TO SAN DIEGO, CA

NIGHTS STAY IN HOTEL:	1	2	3	4	5
AIR FARE (1)	188	188	188	188	188
GROUND TRANSPORTATION (2)	60	120	180	240	300
PER DIEM (3)	76	114	152	190	228
HOTEL/LODGING	72	144	216	288	360
SUBTOTAL	396	566	736	906	1,076
PROVISION FOR COST INCREASE AT 5%	20	28	37	45	54
TOTAL	416	594	773	951	1,130

Note: Add $175 for each additional 24-hour period in the following increments:

GROUND TRANSPORTATION	$ 60
PER DIEM	$ 38
HOTEL/LODGING	$ 72
COST INCREASE PROVISION	$ 5

(1) COACH AIR FARE 7/21/97 $ 188

(2) GROUND TRANSPORTATION INCLUDES:
MILEAGE, PARKING, CAR RENTAL, TAXI/CABFARES

(3) PER DIEM AND HOTEL IN ACCORDANCE WITH JTR

Table IV.8

V. Applicant Qualifications:

AETC, Inc's primary business is advanced algorithm and software development for classified U.S. Navy undersea warfare systems for broadband sonar and magnetic detection sensor systems. AETC has gained an international reputation in the use of these remote sensing technologies to find and identify hidden objects underwater and below ground. This capability is currently being used in and developed for some of the U.S. Defense Department's most advanced underwater and underground detection systems for submarines, mines, unexploded ordinance (UXO) and marine mammal identification (Table V.1). At present, the company has a staff of about thirty five, of which about twenty-five have advanced degrees. The company is employee owned and qualifies Federally as a small disadvantaged company. Corporate headquarters are located in San Diego California with a technical support office in Arlington Virginia. The San Diego facility specializes in naval undersea warfare technologies including advanced broadband acoustic processing for target imaging and in radar imaging of the ocean surface. The Arlington office specializes in electromagnetic remote sensing which has been applied to environmental remediation including UXO, contaminated soils and buried drums. AETC has a growing reputation for tailoring software (algorithms) to find and identify hidden objects without requiring investment in new sensor hardware, thereby extending the life of systems and saving the customer money.

Joseph F. Sabatini, AETC Program Manager: Dr. Sabatini holds a Ph.D. in Physical Chemistry from Princeton University. Dr. Sabatini is responsible for focusing the corporation's extensive expertise in broadband processing, acoustic imaging, and electromagnetic sensing capabilities to solve specific customer needs. Dr. Sabatini has over 20 years' experience in the areas of acoustic and non-acoustic detection of hidden objects. He also has demonstrated the ability to start up and focus small group efforts to attain specific goals. From 1991 to 1993, he initiated and managed the Navy's New Attack Submarine Program Office. From 1994 to 1995, he transformed a small laboratory research effort into a fully functioning, 80 person, high performance computing and software development program, which delivered usable products. He currently manages several acoustic detection programs that apply detection algorithms to remotely measure underwater objects.

Steven L. Schmidt, AETC Principal Investigator: Mr. Schmidt holds an M.S. in Electrical Engineering from the University of Southern California and a B.S. in Mathematics from Jacksonville University, Jacksonville, Florida Mr. Schmidt is a member of the technical staff at AETC, San Diego. He has worked in the area of acoustic signal processing and beamforming since 1991. He has assisted in the design and implementation of a time-domain, wideband beamformer and signal processor (WASP), which has been the primary tool for analyzing results from several in-water experiments. Additionally, Mr. Schmidt developed a tool for characterizing the features of underwater images that are output by WASP using color. He also participated in the Department of Defense's September 1992 Open Ocean Area Characterization Test (ACT I) in the Gulf of Mexico and was the company's sole representative during a similar effort in the Straits of Korea. Mr. Schmidt worked on an acoustic transient detection system and the development of spectral analysis tools on MC3200 vector processor.

Diane S. Moore, AETC Consulting Biologist: Ms. Diane Moore holds a B.S. in Conservation and Resource Studies (with an emphasis in Wildlife Biology and Population Dynamics) from U.C. Berkeley, and an M.S. in Ecology from U.C. Davis. Her graduate research was in fish population dynamics in the Sacramento-San Joaquin Delta. Ms. Moore has twelve years' experience in the management of fisheries, wildlife, and wetland resources, including inventory, impact assessment, permitting, and preparation of various environmental documents. Ms. Moore has assessed impacts of proposed development projects on aquatic and terrestrial resources and on threatened and endangered species throughout California. She has also participated in several investigative studies for state and federal agencies and in formulating plans to optimize and restore biological resources. Ms. Moore was accepted as an expert witness in fisheries biology for both the State Water

Resources Control Board's (SWRCB) 1993 Mono Lake Basin Water Rights hearings and the SWRCB 1995 El Dorado County Water Rights hearings. Ms. Moore has formal training from the Wetland Training Institute in wetland delineation, and in assessing and mitigating impacts to wildlife species using USFWS Habitat Evaluation Procedures (HEP). She also has extensive experience in the application of USFWS Instream Flow Incremental Methodology (IFIM) and stream temperature monitoring. Relative to the proposed project, Ms. Moore played a major role in data collection, analysis, and preparation of Fish Habitat Assessments for ten Trinity River salmon and steelhead spawning tributaries. These investigations involved inventory of both physical habitat variables and fish populations, identification of limiting factors to production (e.g., migration barriers, spawning areas, cover, stream temperatures), and providing recommendations on restoration options to increase production.

Syzygy Technologies specializes in support of design, development, integration, testing, and training of many different C^{3}I (Command, Control, Communications and Information) systems. Specifically, Syzygy has two groups providing on-going support to C^{3}I projects at NRaD. For the past five years, employees now in Syzygy's Operations Group have been solely responsible for verification of all releases of the Operations Support System (OSS) and any related Joint maritime Information Command system (JMCIS) segments. Prior to fleet release, Syzygy employees fully test the proposed software to verify conformance to DOD and customer C^{3}I requirements. To perform this task, Syzygy employees have generated numerous T&E tools which include Testplay and Xrunner scripts. These scripts have helped automate the test process and provide reliable test metrics to NRaD customers. Syzygy has developed the full scope of test documentation to support testing to include test plans, test descriptions, and test reports. The Advanced Development Engineering Group at Syzygy is involved in state-of-the-art development and re-engineering of existing C^{3}I systems such as OSS and JMCIS using object-oriented programming languages and design. Specifically, the Syzygy Advanced Development group are using Web based technology with Java scripts to develop platform independent software which will eventually replace the OSS and related segments. Syzygy employees designed and are currently developing the single message Pipeline (SMP) and Output Message Server (OMS) segments using Java classes in a distributed client-server architecture.

Santos M. Discar, Syzygy Software Engineer: Mr. Discar holds a A.S., Computer Science, from Southwestern College. Mr. Discar has more than ten years of experience in the computer science field, including five years with command, control, and communications intelligence (C^{3}I) systems. As an Army intelligence analyst, he developed software that was based on electronic intelligence (ELINT) analysis techniques, situation analysis, electronic warfare and countermeasures, and command and control (C2). Mr. Discar is conversant in the following computer programming languages: C, C++, Java, BASIC, PASCAL, clipper, dBASE III, Microsoft Visual BASIC and he is familiar with SQL, FORTRAN, Lisp, Forth, COBOL, VAX, MACRO, SQL, and Pilot. Additionally, he is familiar with the Z80, 80x86, 680xx, and 6502 assembly languages. He has been the lead software engineer on the JMCIS OSS (Operations Support System) software development group. Currently developing rearchitectured OSS system using combination of C, C++, and Java programming languages. Responsible for demonstrations and technical lead on all aspects of software development including design of communications interfaces, development of core data base access software, and design of all Object Oriented classes for the system.

Tim Ford, Turlock Irrigation District: Mr. Ford holds a Bachelors of Science degree in Wildlife and Fisheries Biology from U.C. Davis. He is an aquatic biologist with 20 years of professional experience in California with Federal, State and County governments. Since 1981 Mr. Ford has been employed by the Turlock Irrigation District as an aquatic biologist. His current job functions include planning, coordination and conducting aquatic resource programs for the district.

There are no known or anticipated conflicts of interest associated with this program.

Table V.1. Representative Previous Contracts by AETC and Syzygy.

AETC Contracts	
Sponsor/Program Name	**Contract Number**
U.S. Navy, Office of Naval Research	N00014-96-C-0214
Unconventional Broadband Sonar Processing Algorithms	
U.S. Navy, Office of Naval Research	N00014-96-C-0276
Development of Broadband Sonar Algorithms, Design Tools and Performance Models	
U.S. Navy, Office of Naval Research	N00014-97-C-0090
Wideband, Low Frequency Imaging Sonar for Towed Arrays	
U.S. Navy, NRaD - San Diego	N66001-94-C-6005
High Resolution, Low Frequency Undersea Acoustics Imaging Technology	
University of Washington, Applied Physics Lab	Subcontract #513626
High Resolution Processing or Clandestine Mine Surveillance and Classification	
Syzygy Contracts	
U.S. Navy, NRaD	N68786-92-C-1775
Systems Engineering, Software Integration and Testing Support for JMCIS and GCCS	
U.S. Navy, NRaD	N66001-96-D-0010
Test, Engineering, Training and Integration Support for JMCIS and GCCS programs	
U.S. Navy, NRaD	N66001-96-D-8625
Training Research & Demonstration Support at USCINCPAC for Joint Service Exercises	
U.S. Navy, NRaD	N66001-96-M-1250
Training of OSS and NRaD Personnel on Use of Water Space Management, JMCIS and UB Communications	

VI. Compliance, Terms and Conditions

Attached are the Standard Clauses for: Service & Consultant Service Contracts for $5,000 & over. Also, attached are the *Nondiscrimination Compliance Statement* and Small Business Preference Form. Although AETC is a small business, we do not possess a Certification Approval Letter and we are not claiming preference as a small business for this proposal.

The terms and conditions as outlined are acceptable at AETC without exception.

Item 2 (p 1/2)

Agreement No. _____

Exhibit _____

STANDARD CLAUSES - SERVICE & CONSULTANT SERVICE CONTRACTS FOR $5,000 & OVER WITH NONPUBLIC ENTITIES

Workers' Compensation Clause. Contractor affirms that it is aware of the provisions of Section 3700 of the California Labor Code which require every employer to be insured against liability for workers' compensation or to undertake self-insurance in accordance with the provisions of that Code, and Contractor affirms that it will comply with such provisions before commencing the performance of the work under this contract.

Claims Dispute Clause. Any claim that Contractor may have regarding the performance of this agreement including, but not limited to, claims for additional compensation or extension of time, shall be submitted to the Executive Director, CALFED Bay-Delta Program, or its designee, within thirty days of its accrual. State and Contractor shall then attempt to negotiate a resolution of such claim and process an amendment to this agreement to implement the terms of any such resolution. (NFWF)

National Labor Relations Board Clause. In accordance with Public Contract Code Section 10296, Contractor declares under penalty of perjury that no more than one final, unappealable finding of contempt of court by a federal court has been issued against the Contractor within the immediately preceding two-year period because of Contractor's failure to comply with an order of a federal court which orders Contractor to comply with an order of the national Labor Relations Board.

Nondiscrimination Clause. During the performance of this contract, the recipient,Ccontractor and its subcontractors shall not deny the contract's benefits to any person on the basis of religion, color, ethnic group identification, sex, age, physical or mental disability, nor shall they discriminate unlawfully against any employee or applicant for employment because of race, religion, color, national origin, ancestry, physical handicap, mental disability, medical condition, marital status, age (over 40), or sex. Contractor shall insure that the evaluation and treatment of employees and applicants for employment are free of such discrimination. Contractor shall comply with the provisions of the Fair Employment and Housing Act (Government Code Section 12900 et seq.), the regulations promulgated thereunder (California Administrative Code, Title 2, Sections 7285.0 et seq.), the provisions of Article 9.5, Chapter 1, Part 1, Division 3, Title 2 of the Government Code (Government Code Sections 11135 - 11139.5), and the regulations or standards adopted by the awarding State agency to implement such article. Contractor or recipient shall permit access by representatives of the Department of Fair Employment and Housing and the awarding State agency upon reasonable notice at any time during the normal business hours, but in no case less than 24 hours' notice, to such of its books, records, accounts, other sources of information and its facilities as said Department or Agency shall require to ascertain compliance with this clause. Recipient, Contractor and its subcontractors shall give written notice of their obligations under this clause to labor organizations with which they have a collective bargaining or other agreement. The Contractor shall include the nondiscrimination and compliance provisions of this clause in all subcontracts to perform work under the contract.

Statement of Compliance. The Contractor's signature affixed hereon and dated shall constitute a certification under penalty of perjury under the laws of the State of California that the Contractor has, unless exempted, complied with the nondiscrimination program requirements of Government Code Section 12990 and Title 2, California Code of Regulations, Section 8103.

Performance Evaluation. For consulting service agreements, Contractor's performance under this contract will be evaluated after completion. A negative evaluation will be filed with the Department of General Services.

Category III

Availability of Funds. Work to be performed under this contract is subject to availability of funds.

Audit Clause. For contracts in excess of $10,000, the contracting parties shall be subject to the examination and audit of the State Auditor for a period of three years after final payment under the contract. (Government Code Section 8546.7).

Payment Retention Clause. Ten percent of any progress payments that may be provided for under this contract shall be withheld per Public Contract Code Sections 10346 and 10379 pending satisfactory completion of all services under the contract.

Reimbursement Clause. If applicable, travel and per diem expenses to be reimbursed under this contract shall be at the same rates the State provides for unrepresented employees in accordance with the provisions of Title 2, Chapter 3, of the California Code of Regulations. Contractor's designated headquarters for the purpose of computing such expenses shall be: San Diego, CA

Termination Clause. The State may terminate this contract without cause upon 30 days' advance written notice. The Contractor shall be reimbursed for all reasonable expenses incurred up to the date of termination.

Minority/Women/Disabled Veteran Business Enterprise Participation Requirement Audit Clause. Contractor or vendor agrees that the awarding department or its delegates will have the right to review, obtain, and copy all records pertaining to performance of the contract. Contractor or vendor agrees to provide the awarding department or its delegatee access to its premises, upon reasonable notice, during normal business hours for the purpose of interviewing employees and inspecting and copying such books, records, accounts, and other material that may be relevant to a matter under investigation for record keeping purposes. Contractor or vendor further agrees to maintain such records for a period of three (3) years after final payment under the contract. Title 2 CCR Section 1896.75.

Priority Hiring Considerations. For contracts in excess of $200,000, the Contractor shall give priority consideration in filling vacancies in positions funded by the contract to qualified recipients of aid under Welfare and Institutions Code Section 11200. (Public Contract Code Section 10353)

Item 2
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Drug-Free Workplace Certification. By signing this contract, the Contractor or grantee hereby certifies under penalty of perjury under the laws of the State of California that the Contractor or grantee will comply with the requirements of the Drug-Free Workplace Act of 1990 (Government Code Section 8350 et seq.) and will provide a drug-free workplace by taking the following actions:

1. Publish a statement notifying employees that unlawful manufacture, distribution, dispensation, possession, or use of a controlled substance is prohibited and specifying actions to be taken against employees for violations.

2. Establish a Drug-Free Awareness Program to inform employees about all of the following:

   (a) The dangers of drug abuse in the workplace,
   (b) The person's or organization's policy of maintaining a drug-free workplace,
   (c) Any available counseling, rehabilitation and employee assistance programs, and
   (d) Penalties that may be imposed upon employees for drug abuse violations.

3. Every employee who works on the proposed contract or grant:

   (a) Will receive a copy of the company's drug-free policy statement, and
   (b) Will agree to abide by terms of the company's statement as a condition of employment on the contract or grant.

This contract or grant may be subject to suspension of payments or termination, or both, and the Contractor or grantee may be subject to debarment if the department determines that: (1) the Contractor or grantee has made a false certification, or (2) the Contractor or grantee violates the certification by failing to carry out the requirements noted above.

Antitrust Claims. In submitting a bid to a public purchasing body, the bidder offers and agrees that if the bid is accepted, it will assign to the purchasing body all rights, title, and interest in and to all causes of action it may have under Section 4 of the Clayton Act (15 U.S.C. Sec. 15) or under the Cartwright Act (Chapter 2 (commencing with Section 16700) Part 2 of Division 7 of the Business and Professions Code), arising from purchases of goods, materials, or services by the bidder for sale to the purchasing body pursuant to the bid. Such assignment shall be made and become effective at the time the purchasing body tenders final payment to the bidder. See Government Code Section 4552.

If an awarding body or public purchasing body received, either through judgment or settlement, a monetary recovery for a cause of action assigned under this chapter, the assignor shall be entitled to receive reimbursement for actual legal costs incurred and may, upon demand, recover from the public body any portion of the recovery, including treble damages, attributable to overcharges that were paid by the assignor but were not paid by the public body as part of the bid price, less the expenses incurred in obtaining that portion of the recovery. See Government Code Section 4553.

Upon demand in writing by the assignor, the assignee shall, within one year from such demand, reassign the cause of action assigned under this part if the assignor has been or may have been injured by the violation of law for which the cause of action arose and (a) the assignee has not been injured thereby, or (b) the assignee declines to file a court action for the cause of action. See Government Code Section 4554.

Americans With Disabilities Act. By signing this contract, Contractor assures the state that it complies with the Americans With Disabilities Act (ADA) of 1990, (42 U.S.C. 12101 et seq.), which prohibits discrimination on the basis of disability, as well as all applicable regulations and guidelines issued pursuant to the ADA.

Corporate Qualifications To Do Business in California. Contractor must be currently qualified to do business in California as defined by the Revenue & Taxation Code, Section 23101 unless exempted. Both domestic and foreign corporations (those incorporated outside of California) must be in good standing in order to be qualified to do business in California.

Conflict of Interest. Current State Employees: a) No State officer or employee shall engage in any employment, activity or enterprise from which the officer or employee receives compensation or has a financial interest and which is sponsored or funded by any State agency, unless the employment, activity or enterprise is required as a condition of regular State employment. b) No State officer or employee shall contract on his or her own behalf as an independent contractor with any State agency to provide goods or services.

Former State Employees: a) For the two-year period from the date he or she left State employment, no former State officer or employee may enter into a contract in which he or she engaged in any of the negotiations, transactions, planning, arrangements or any part of the decision-making process relevant to the contract while employed in any capacity by any State agency. b) For the twelve-month period from the date he or she left State employment, no former State officer or employee may enter into a contract with any State agency if he or she was employed by that State agency in a policy-making position in the same general subject area as the proposed contract within the twelve-month period prior to his or her leaving State service.

Item 8

NONDISCRIMINATION COMPLIANCE STATEMENT

COMPANY NAME

AETC INCORPORATED

The company named above (hereinafter referred to as "prospective contractor") hereby certifies, unless specifically exempted, compliance with Government Code Section 12990 (a-f) and California Code of Regulations, Title 2, Division 4, Chapter 5 in matters relating to reporting requirements and the development, implementation and maintenance of a Nondiscrimination Program. Prospective contractor agrees not to unlawfully discriminate, harass or allow harassment against any employee or applicant for employment because of sex, race, color, ancestry, religious creed, national origin, disability (including HIV and AIDS), medical condition (cancer), age, marital status, denial of family and medical care leave and denial of pregnancy disability leave.

CERTIFICATION

I, the official named below, hereby swear that I am duly authorized to legally bind the prospective contractor to the above described certification. I am fully aware that this certification, executed on the date and in the county below, is made under penalty of perjury under the laws of the State of California.

OFFICIAL'S NAME

Steven P. Sands

DATE EXECUTED

22 July 1997

EXECUTED IN THE COUNTY OF

San Diego

PROSPECTIVE CONTRACTOR'S SIGNATURE

PROSPECTIVE CONTRACTOR'S TITLE

Vice President, Finance and Administration

PROSPECTIVE CONTRACTOR'S LEGAL BUSINESS NAME

AETC Incorporated

Item 12

Agreement No. _____

Exhibit _____

STANDARD CLAUSES --
SMALL BUSINESS PREFERENCE AND CONTRACTOR IDENTIFICATION NUMBER

NOTICE TO ALL BIDDERS:

Section 14835, et. seq. of the California Government Code requires that a five percent preference be given to bidders who qualify as a small business. The rules and regulations of this law, including the definition of a small business for the delivery of service, are contained in Title 2, California Code of Regulations, Section 1896, et. seq. A copy of the regulations is available upon request. Questions regarding the preference approval process should be directed to the Office of Small and Minority Business at (916) 322-5060. To claim the small business preference, you must submit a copy of your certification approval letter with your bid.

Are you claiming preference as a small business?

_____ Yes* _X_ No

*Attach a copy of your certification approval letter.